Virtual Reality Applied to Oil and Gas Well Design

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Goal

- **Optimize drilling planning:**
  - Efficiency, economics, safety, and success rates.

- **Range of application:**
  - Individual well plans
  - Field development planning
  - Infill drilling

Approach

- **Display all geological, geophysical and "cultural" data**

- **Integrate drilling engineering algorithms**

- **Immersive display and 3-D interaction with well designs**

- **Economic analysis and feedback during design**

Approach

- **Integration of disciplines**
  - Geologist, Geophysicist, Drilling Engineer, Reservoir Engineer

- **Shared data and functionality across a range of platforms**

- **"Real-time" feedback & planning while drilling**

Immersive Environment

A MechDyne MDFlex

- **12 x 12 x 10 ft (l x w x h)**
- **Intersense 900 tracker**
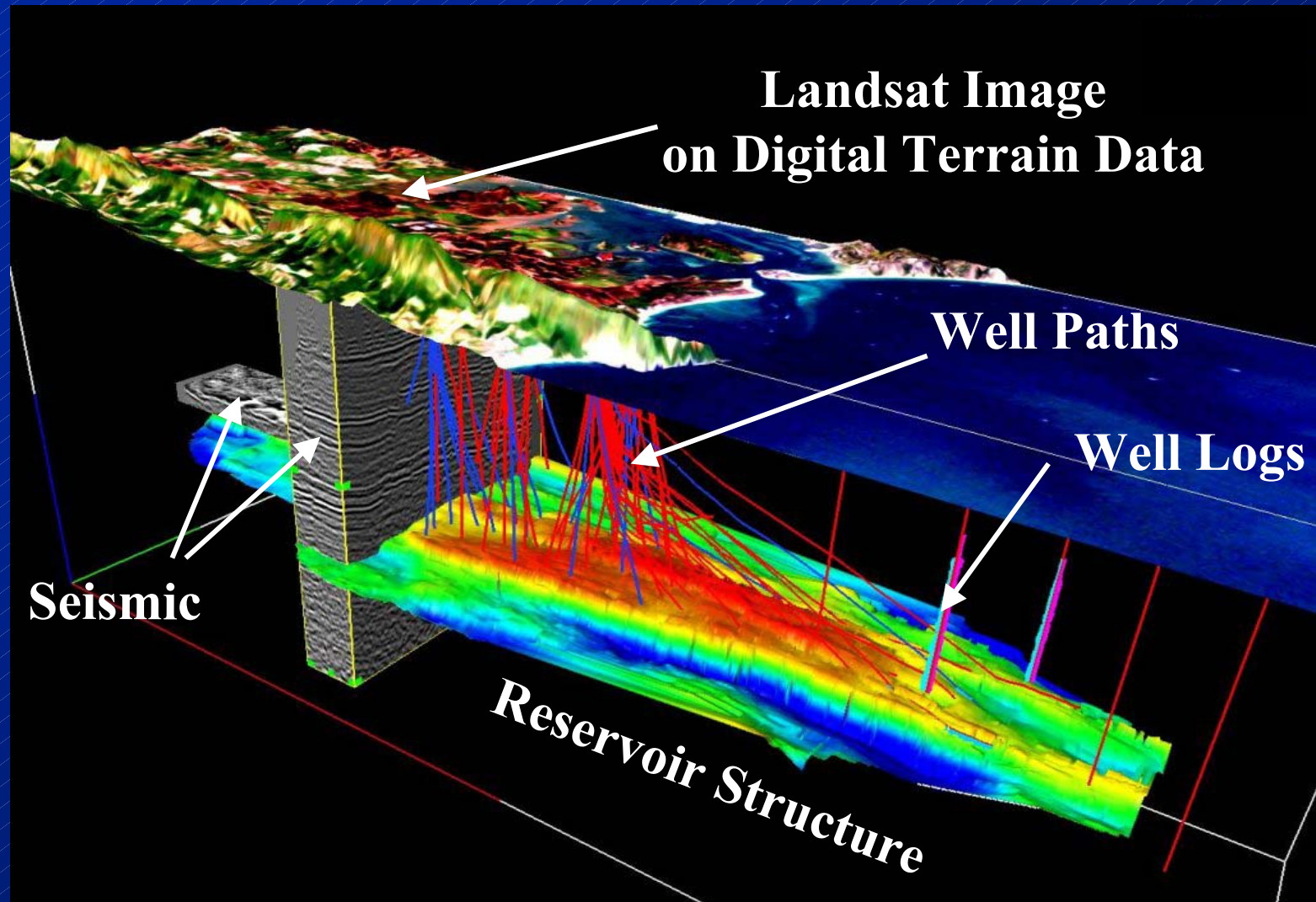- **Barco Reality 909 projectors**
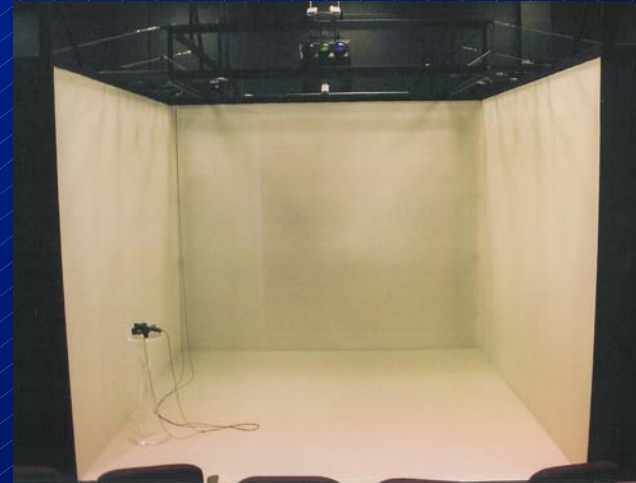
Visualization Computer

- **Immersive Environment**
  - **SGI Onyx 3800:**
    - **4 IR3 Graphics Pipes**
    - **20 GB RAM**
    - **20 R 12K Processors**
    - **3.5 TB Fiber Channel Disk**
- **Desktop**
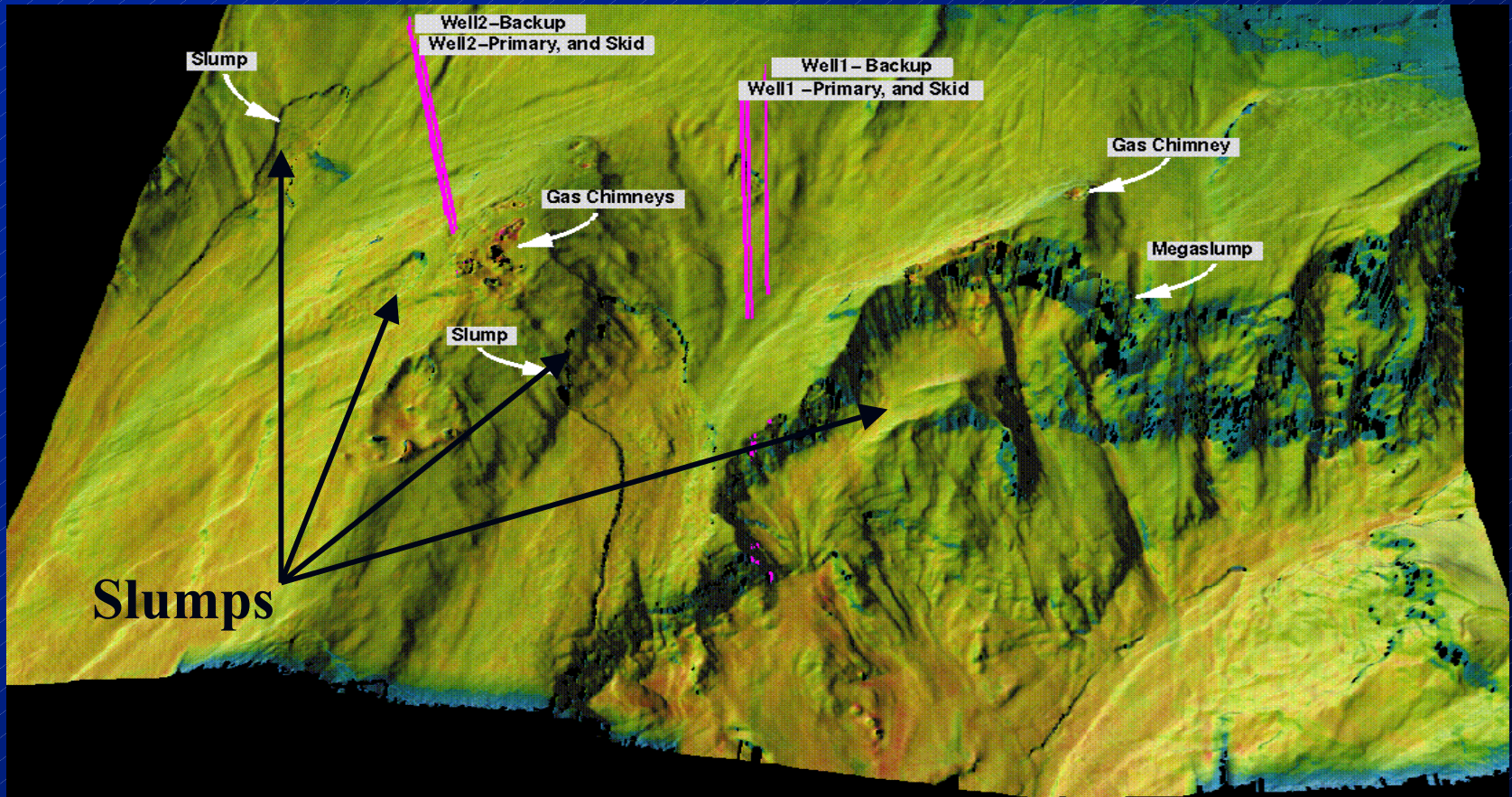 - **SGI Octane/Octane2/Fuel**
- **Drilling Platform**
  - **Laptop**

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The Problem - Data Integration

Landsat Image
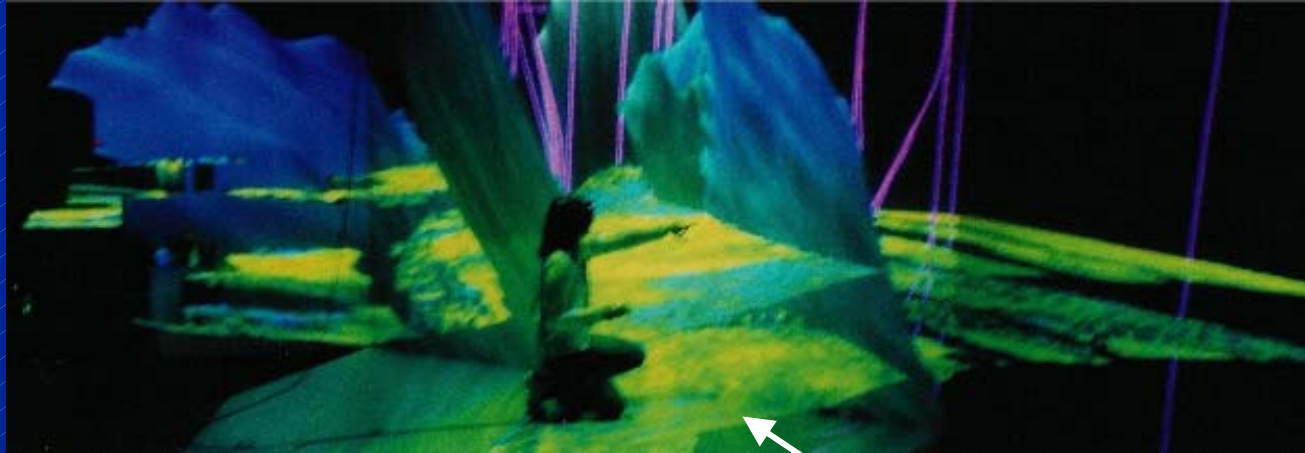on Digital Terrain Data

Well Paths

Well Logs

Seismic

Reservoir Structure

The Problem
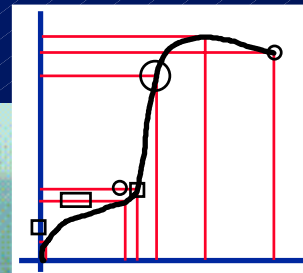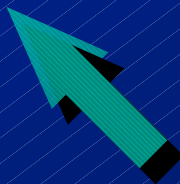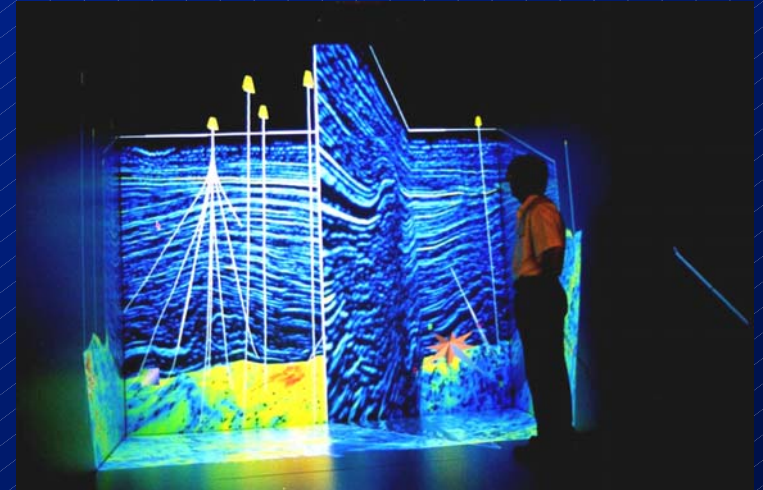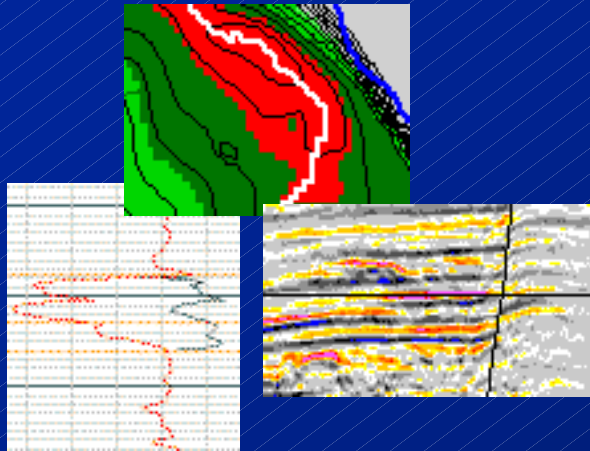## Hazard Mitigation

The Problem
Local and Remote Collaboration

Virtual teams need to collaborate between operating offices, with the desktop, and with the engineer on the platform
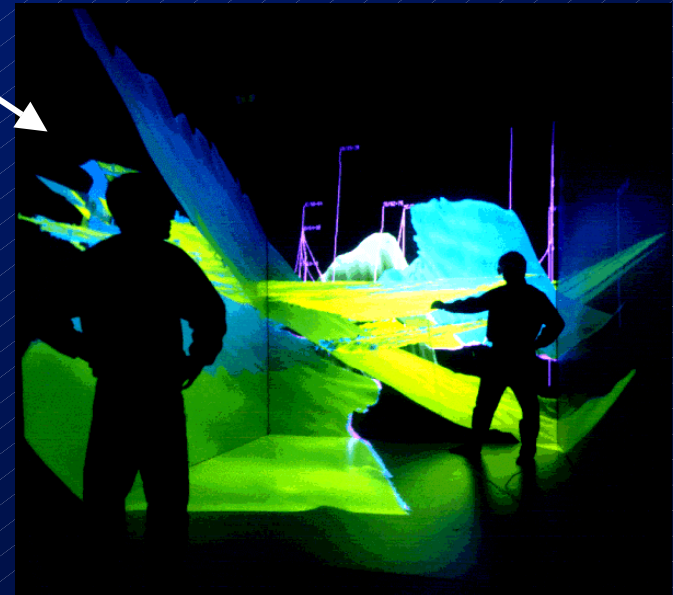
Immersive Drilling Planner

System Features

- **Targets**
  - Definition, selection, editing
- **Well path design and editing**
  - Individual wells, multiple wells, sidetracks
  - Target, path, horizontal section,kickoff depth, …

- **Platform design, optimization and editing**
  - Position, orientation, target/slot assignment
- **Well path uncerainthy**
- **Collision risk display**
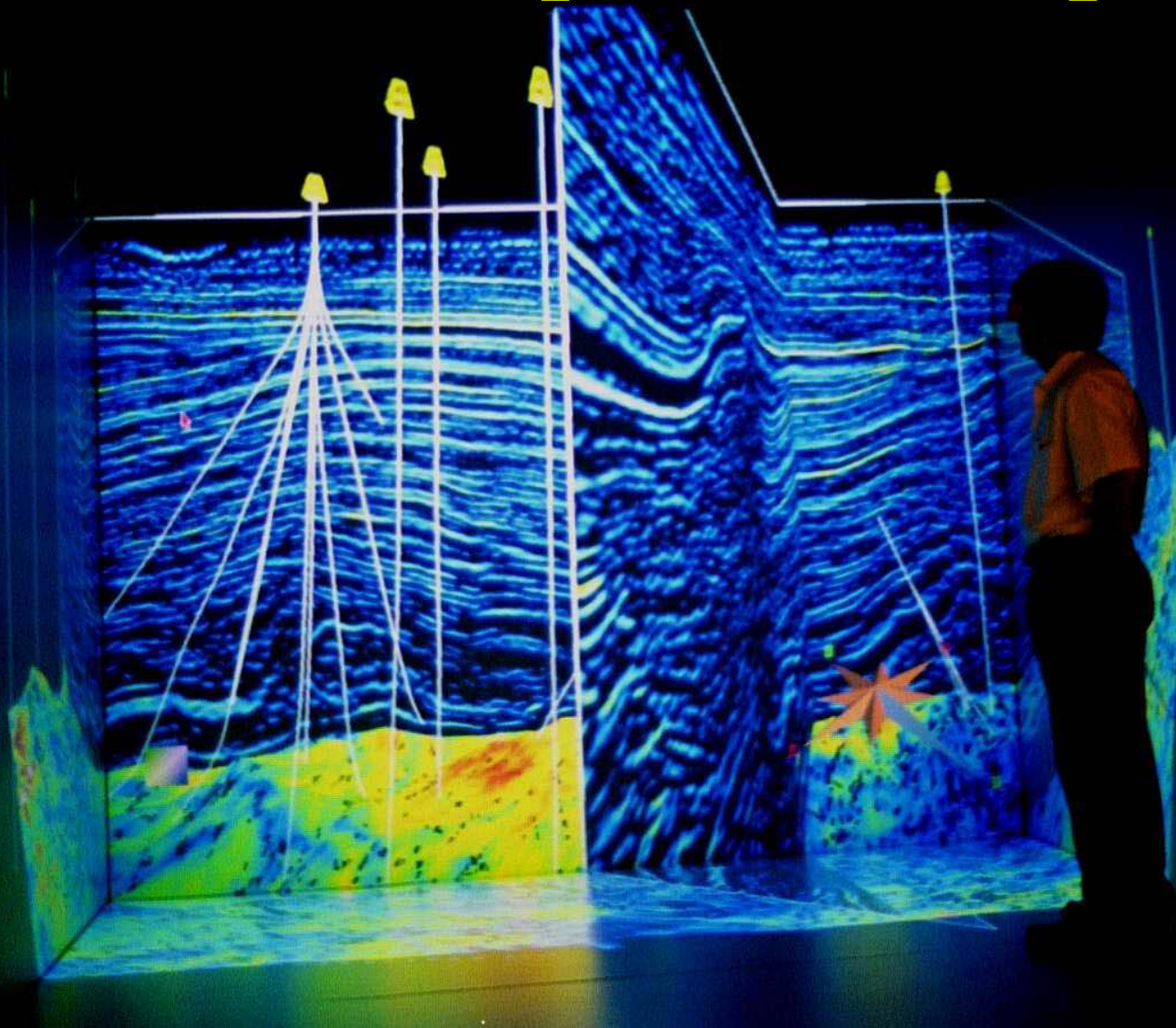- **Complexity measure**
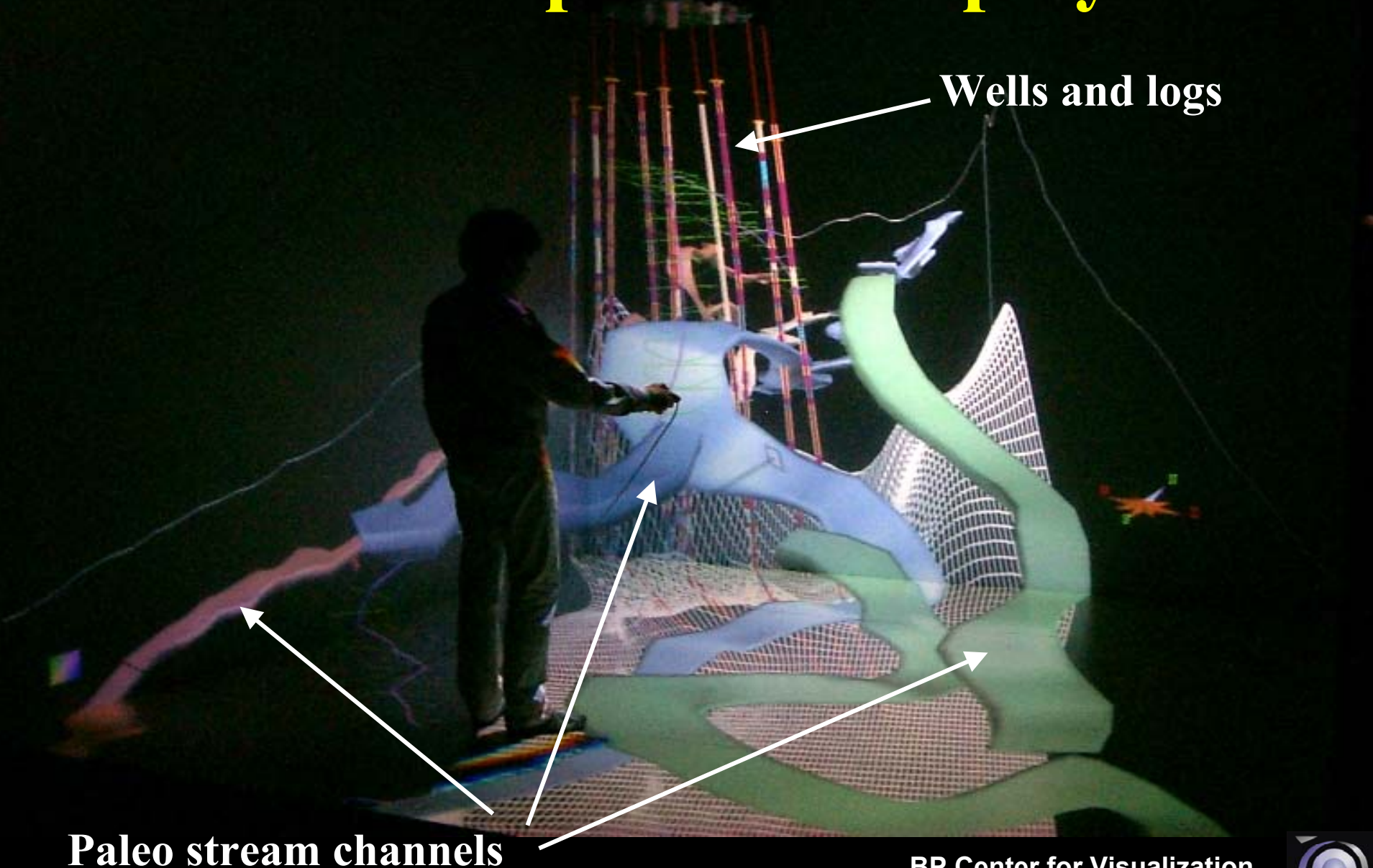- **Economic "optimization"**

Input/Displayed Data

- **Well and platform design constraints**
  - Configuration, kickoff depth, nudge depth, max dogleg severity, …
- **Well Data**
  - Paths, logs, dogleg severity, …
- **Bathymetry and topography**

- **Cultural data**
- **Drilling hazards**
- **Seismic Data**
  - Sections, volumes
- **Interpretation**
  - Horizons and fault
  - "Geobodies"
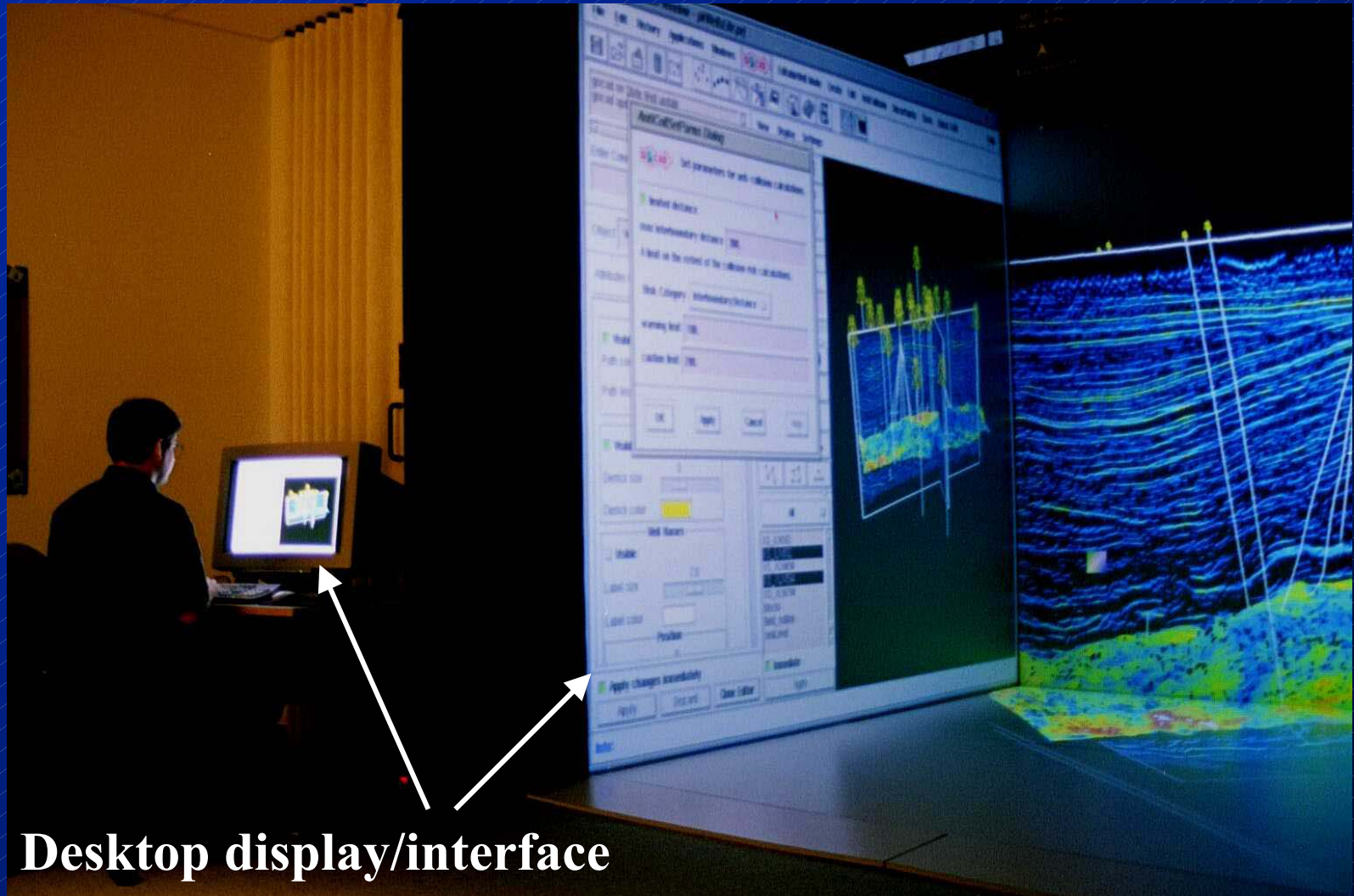 - Attributes
- **Reservoir models**
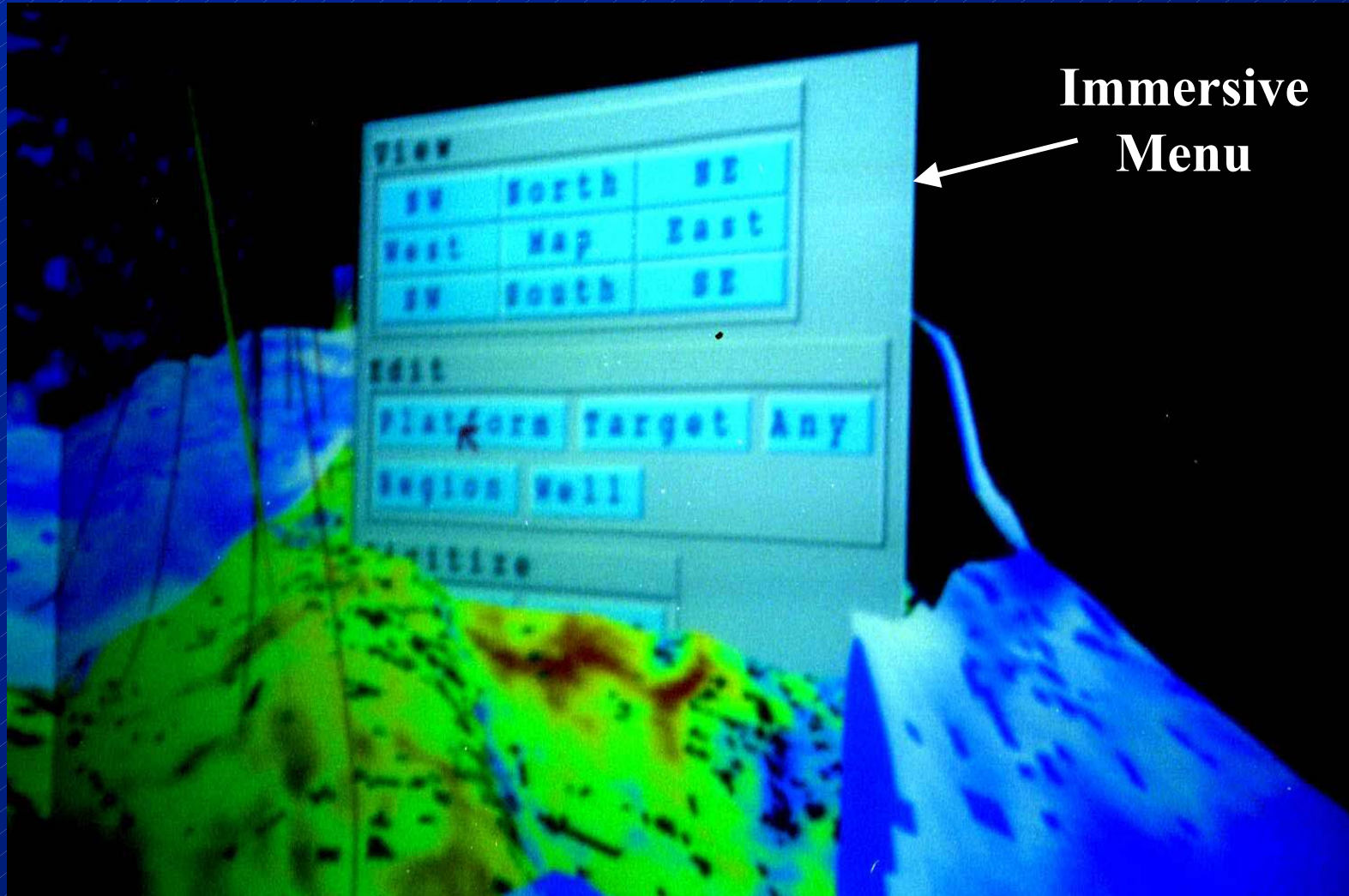
Data Input and Display

Data Input and Display

Wells and logs

Paleo stream channels

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User Interface

Desktop display/interface

User Interface

Immersive Menu

Platform and Target Selection

Targets

Horizontal Section

Platform Location

Platform Planning

Top View

Platform Location

Well Paths

Side View

Well Path Uncertainty

Platform
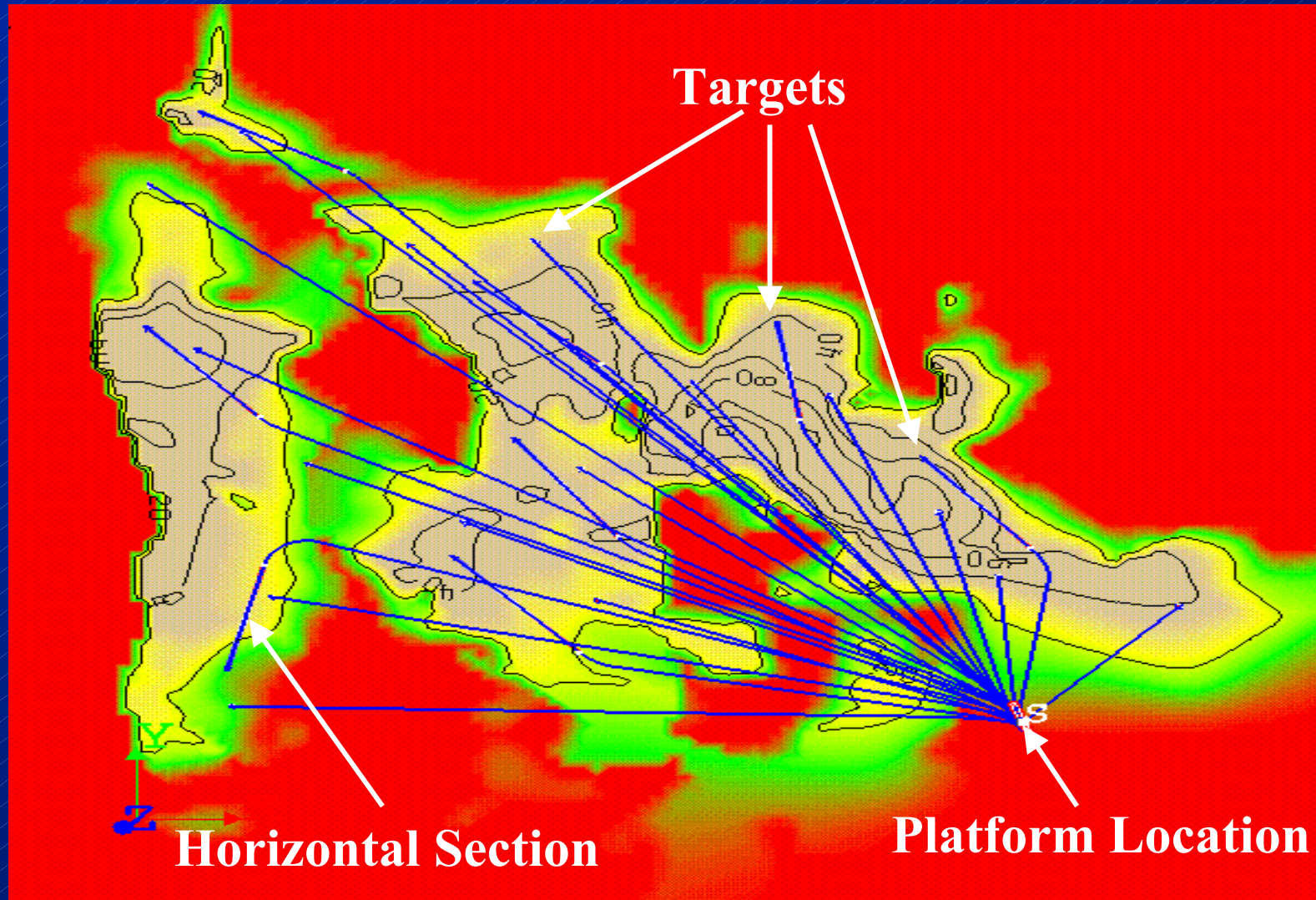
Uncertainty Cone
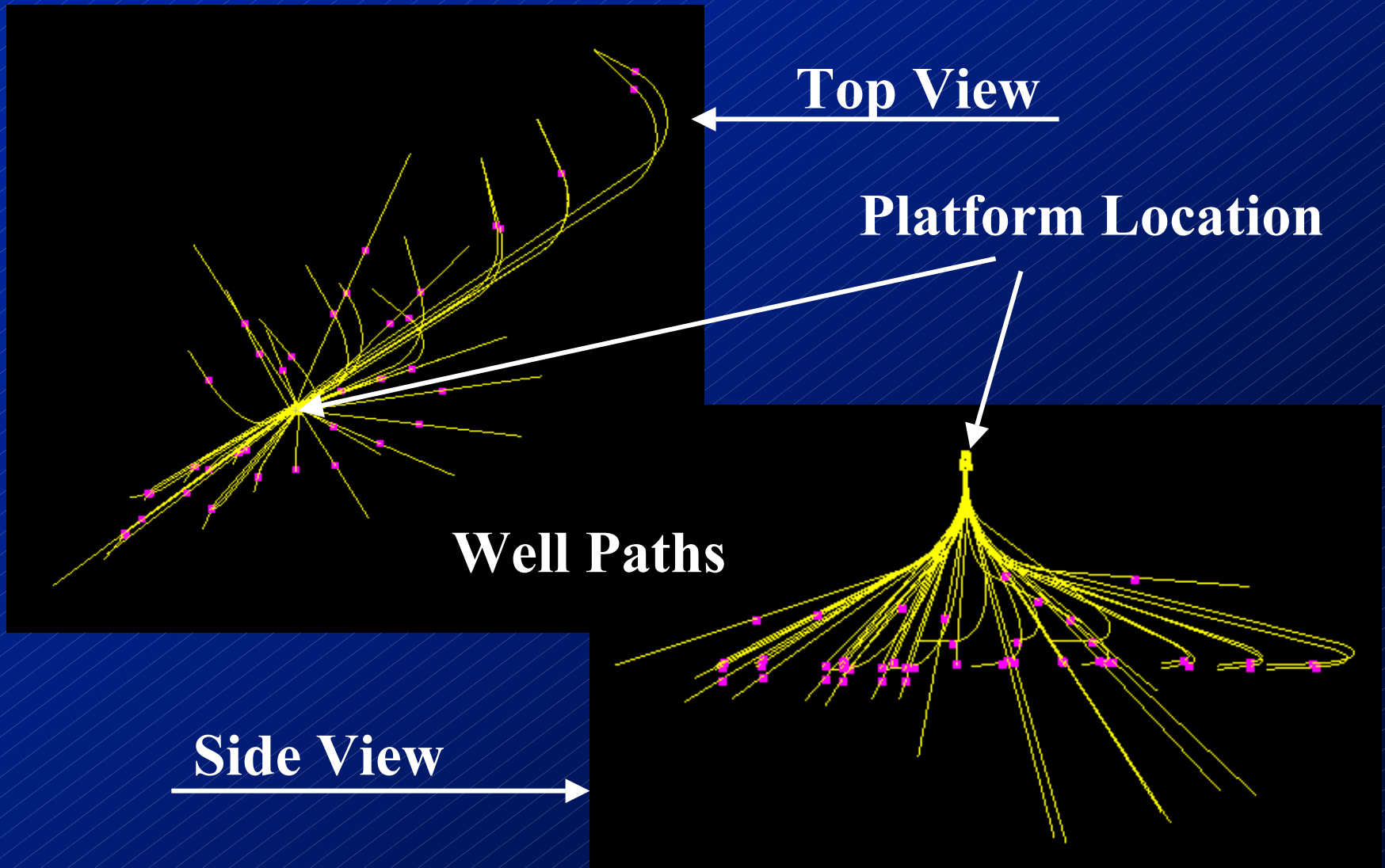
Well Collision Risk
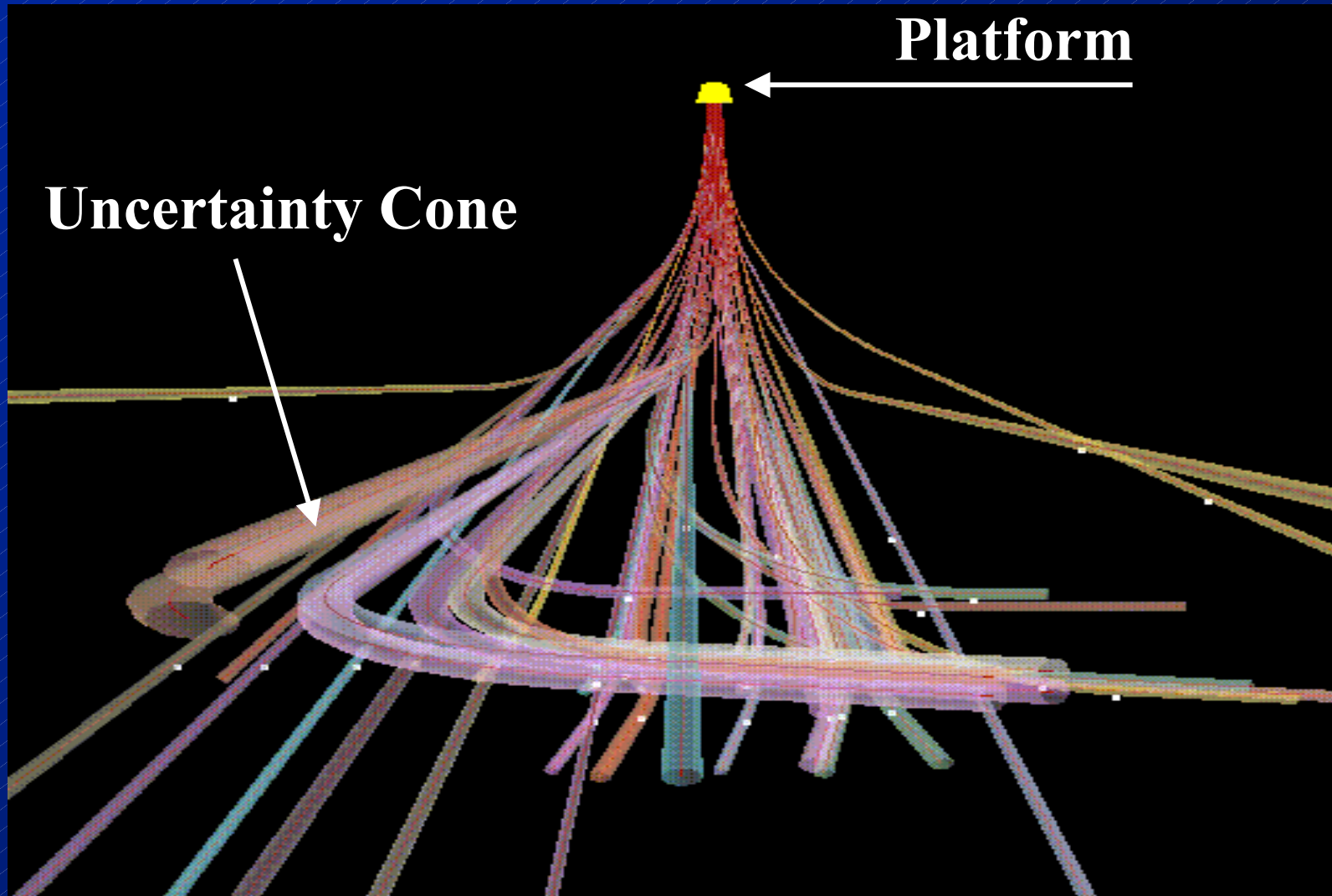
Well path closest approach "screens"
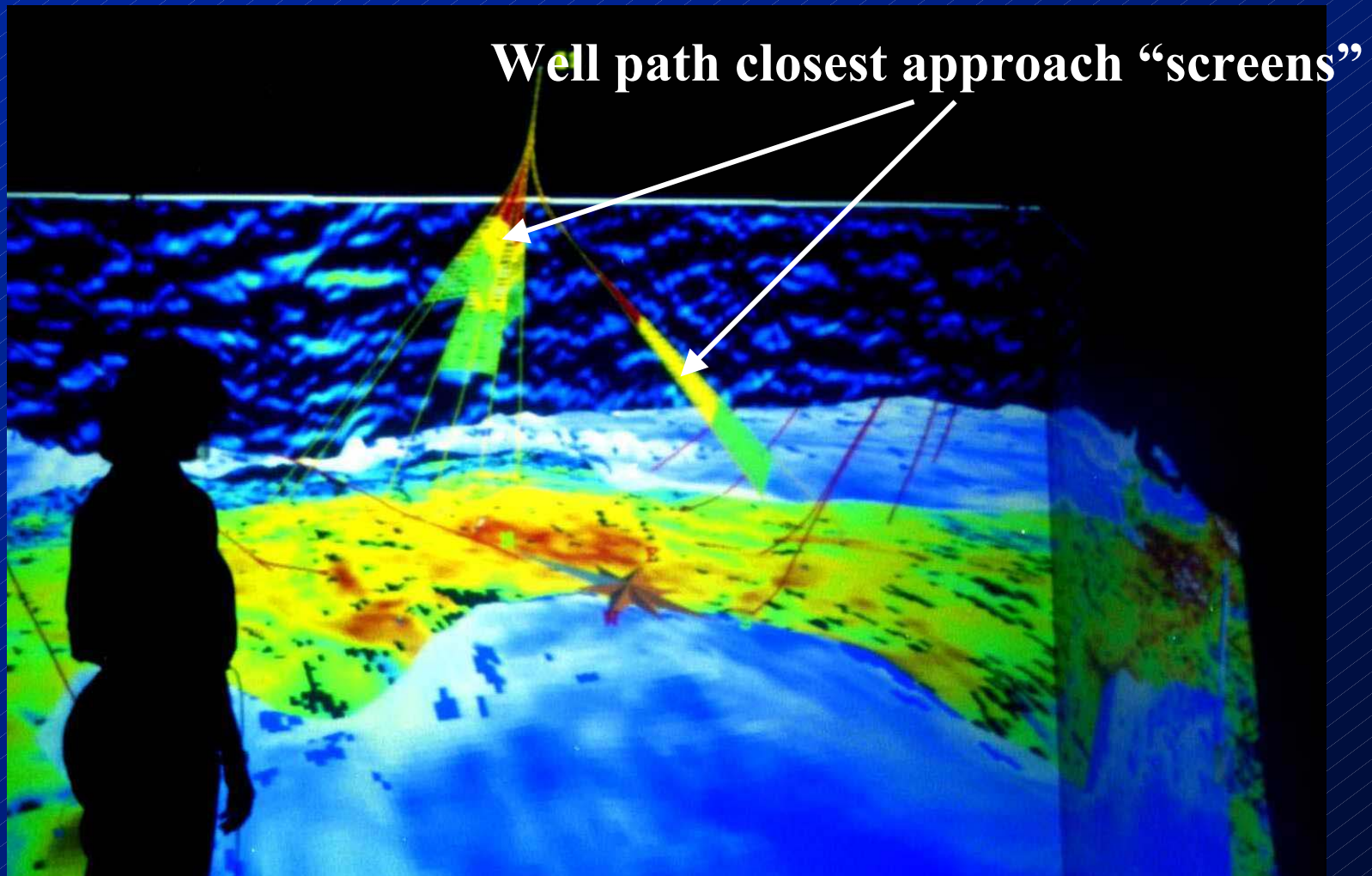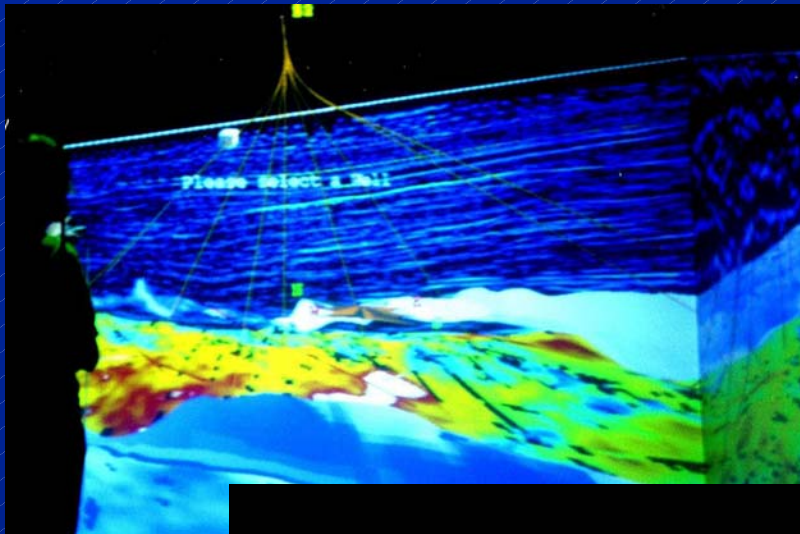
Closest approach between well paths or uncertainty cones
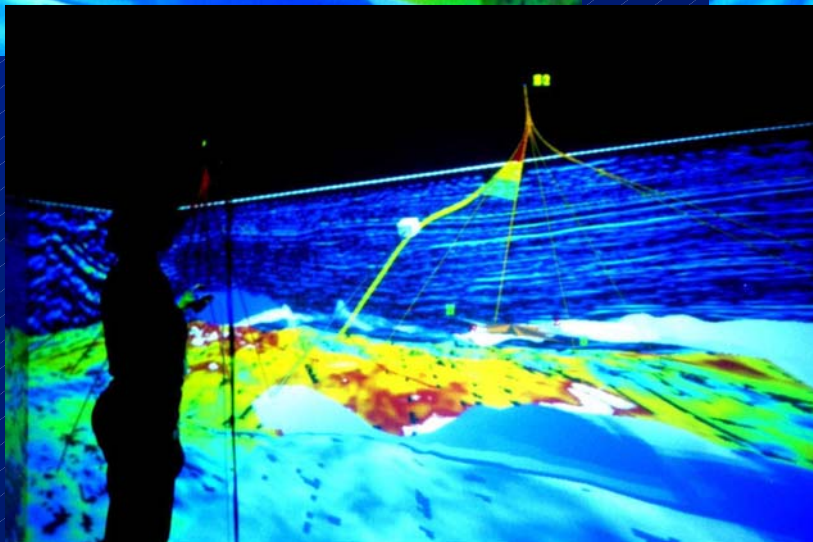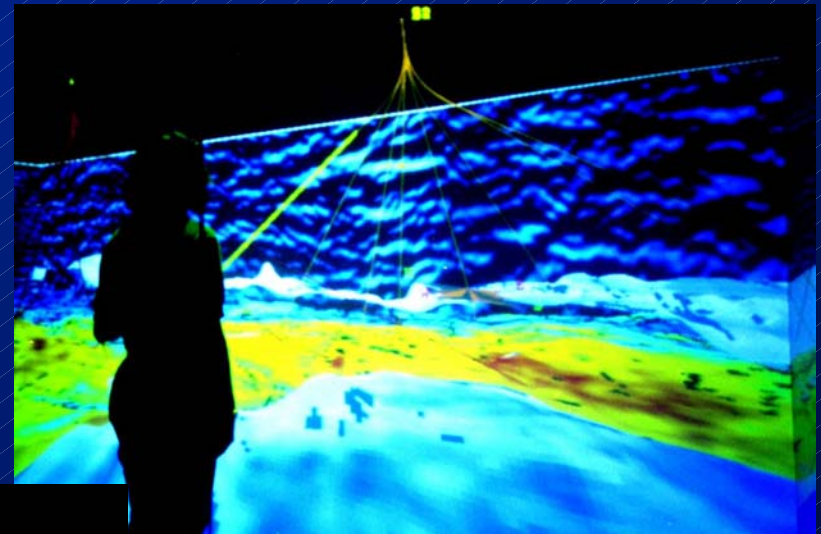
Well Path Editing

Select a well

Define segment to edit

Edit well path segment

Benefits of Immersive Well Planning

- **Effective communication and collaboration**
  - **50% of utilization for review/decision meetings**

- **Cycle time reduction**
  - **50 well development program planned in 3 days instead of 3 months**

Benefits of Immersive Well Planning

- **Improved success rates**
  - **Optimize economics**
  - **Minimize mistakes**
    - **Optimize platforms for infill wells, avoid existing infrastructure**
  - **Maximize safety**
    - **Avoid loss of well an platform**
    - **Avoid sea floor slumps, test exploration targets, optimize economics**

Reasons for Improved Results

- **Integration of data**
- **Integration of discipline specialists**
- **Collaboration**
- **Intuitive display and interaction in 3D**
- **Rapid re-planning to accommodate "reality"**

Continuing R & D
IDP Consortium

- "Brownfield" drilling

- VR interface and 3D manipulation

- Geological/geophysical uncertainties

- Additional engineering calculations

- Tele-collaboration

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